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The geological law of the continents and 'oceans' autonomous development: from plate tectonics to Globalcosmogeotectonic

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ABSTRACT

The problem of the Earth's continents origin emerged in the 17th century but it solving has become possible only today. Foundation of the continents consisting from the lower basalt layer and upper granite-gneiss, was formed in Hadean and Archean time. In Proterozoic and Fanerozoic time on this foundation was created put down blocks, top blocks and geosyncline-fold belts on the edges of it. The other part of the Earth's surface was covered of ancient primary crystal proto-crust of the peridotite composition. It was changed only in Mesozoic and Kainozoic time when it have been lowered, filled ocean water and covered layer of young basalt. The continents are active sial growths on peridotite body of the Earth.

Keywords: continents, active development, sial growths, passive peridotite mantle

1. TOPICALITY OF A PROBLEM

The issue pertaining to the origin of continents emerged in the 17th century when the first globe was made. F. Bacon, an English philosopher, was the first man to observe the specific structural features of the continents. Numerous peculiarities in the geographic form and structure of the continents were eventually established in the 18th to 19th century. However, geographic science at that time (as well as now) could not determine the origin of continents so far as it task out of possibilities of this science.

In 1873 in geology there was American geologist D. Dana's idea of initially fixed position of continents, with their light crust and territories with heavy basalt crust out of them, owing to cooling and hardening of crust on surface of the cooling hot Earth (Hallam. 1985). This concept gained development in 1909 in paper of the great Austrian geologist E. Suess which came to conclusion that "positions of continents are the fixed and constant and that hollows of the oceans dividing them, resulted from immersion of large mass of land" (Carey, p. 336).

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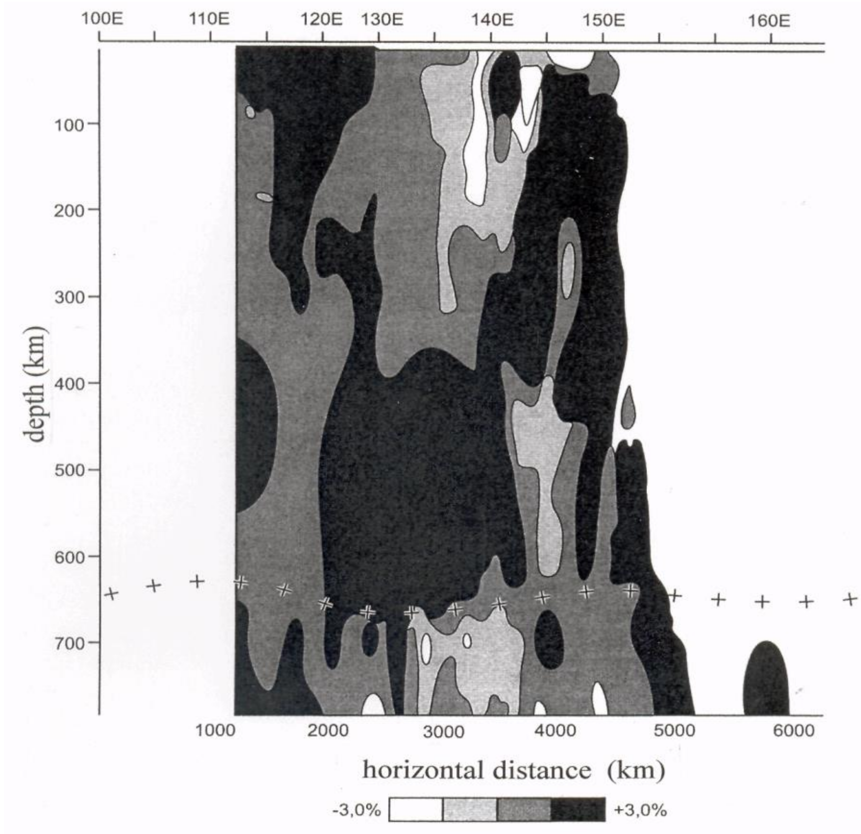

Figure 1

Seismotomographic section on line: Pacific Ocean – South Sakhalin – Chita city (Van der Hilst et el. 1993). On the Sakhalin's sides are vertical interrupting pillars of the hot mantle (white) with lowered velocity of longitudinal seismic waves. They are crossing upper mantle and last in down mantle.

In the first half of the XX century it is situation developed Ch. Schuchert, H. Jeffreys, V.A. Magnitsky and others researchers. American geologist Ф. Кинг had concluded: «the fundamental difference between continental and oceanic crust says that oceanic crust is so steady in time, as well as continental platforms… It is difficult to allow possibility of transformation by any known geological processes continental sial in oceanic sima "(Rezanov. p. 84).

However the established geological facts were not estimates as reality, characteristic for different territories of a planet. And by consideration of all crust of the planet some researchers gave preference to illegal assumptions. In particular it was appeared assumption that all crust was in the beginning continental (sial) crust and then the part of it (under oceans) was brought down, transformed and turned into the peridotite crust (Belousov. 1962). Thereby they repeated the great an error of illegal extrapolation allowed in the XVIII century by A. Verner and G. Getton (Zhirnov. 2007).

Other researchers (mainly geophysics) offered in 1963–1966 plate-tectonics' hypothesis – not geological character and completely presumable. They ignored previous geological data, excluded continents as specific objects and divided all earth crust on seven lithosphere plates, with borders along breaks with modern tectonic seismic activity. Plates had to move on thousands kilometers, hollow to be bent (with small angle) under continents and to plunge deeply into a mantle. But great English geophysicist H. Jeffreys and the Soviet geologists–academicians had examined this hypothesis as fantastic (Hallam. 1985, Kosygin. 1988). The same fantastic it remains and now (Blyuman. 2013, Kuprin. 2010, Basiliev.2009, Zhirnov. 2007). In particular, available data on geology of the World Ocean, based on the considered materials of deep-water drilling, don't testify in favor of their compatibility with basic provisions of plate tectonics (Blyuman. 2013). And also:"according to seismotomographic researches of the Earth's mantle existence in it horizontally focused convective streams isn't establishment… it means that the substance of a mantle experiences mainly ascending movements» (Kuprin, 2010. p. 68). It is possible to give a section of crust and mantle of the Far East and the Pacific Ocean as an example (Figure 1).

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2. SCOPE OF THE STUDY

The aim of carrying out this research is to establish the position of the planetary geological structures – continents and 'oceans' and determine peculiarities evolution of these structures in time. This theme is researching many scientists during very long time. But many new data appeared so far give the chance to specify significantly existing representations on this matter and to offer the new conception.

2.1. Materials

The materials used include the author's papers on the theme, synthesis and critical analyses of the published materials.

2.2. Methodology

For solution the matter were used the new data of the geographic and geological maps and the new geology-geophysics sections of the large geological structures.

3. RESULTS

3.1. Geographic regularities of the position and structure of the continents

In 1892, Humboldt, a well-known traveller, found that the regularities of mountain ridges were found mainly along the longitude and latitude directions. M. Bertran, a geologist, supported this (Sholpo. 1986). A. Reclus, a great geographer and traveller, generalized the special geographical features of the Earth: 1) the northern continent hemisphere and the southern oceanic, 2) the triangular forms of all continents that narrowed to the south, and 3) the bending of the southern ends of the continents to the east, especially the large bend near the south-eastern part of Asia (Sholpo. 1986). The great chain of islands in this region bends to the south-east along the latitude direction.

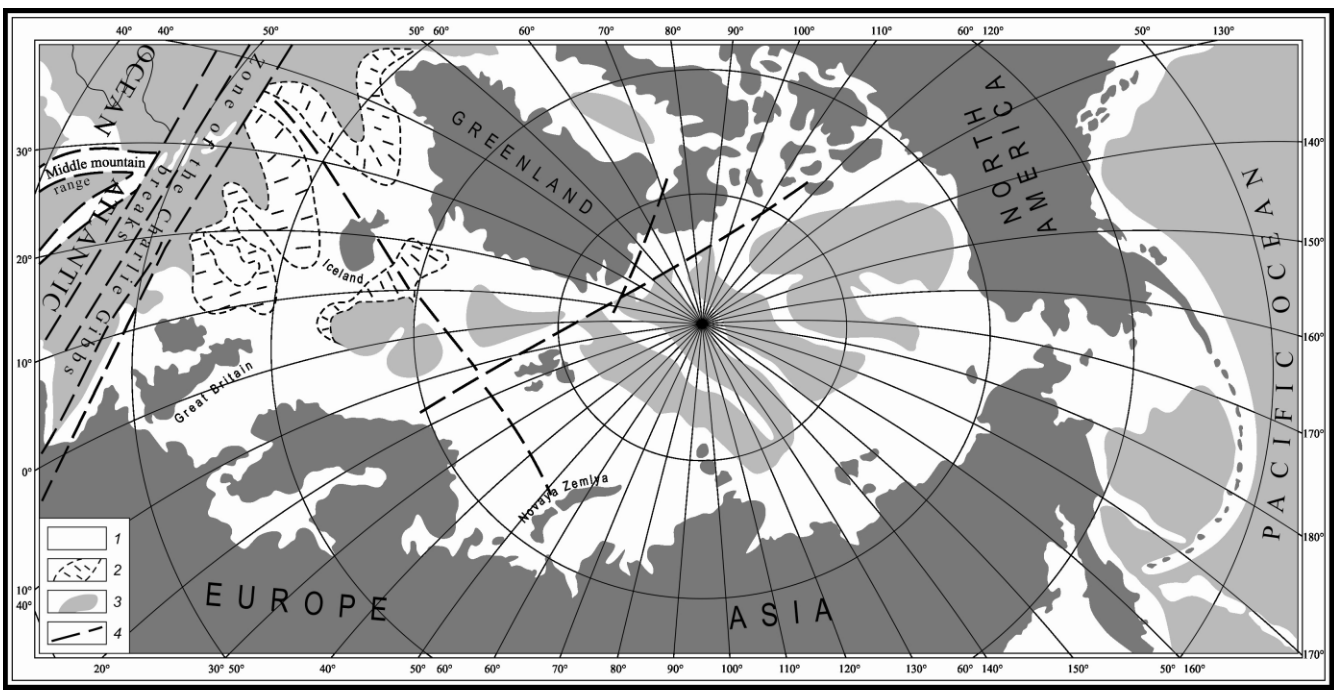

Figure 2

Position Arctic continent under shallow water of North Ice Ocean and barrier restriction of the Middle-Atlantic mountain ridge by Charley Gibbs' diametrical zone faults. Taking into account data (Serpuhov et el. 1976, Khain et el.2005, Kashubin et el. 2013).
1 –shallow water; 2 –continental slopes of mountain ranges – under shallow water; 3 –deep water pits; 4 – the main faults.

3.2. Geological structures of the planet

The structure of the Earth's crust comprises two planetary geological types: continental and oceanic. Most of the continents are concentrated in the north-western part of the hemisphere. In the east of this region lies the Pacific Ocean. Besides there are two continents that cover the polar regions of the planet: the Northern (Arctic) continent under the North Ocean and the Antarctic continent covered with a thick layer of ice. All continents are characterized of the specific type of the Earth's crust that very differing

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from the oceanic crust in the bottom of the oceans - on composition, structure, history and direction of geological development. Continents are initially active geological bodies, oceanic earth crust – initially passive geological structure (Belousov. 1962, Blyuman. 2013, Resanov. 1983, Zhirnov. 2008).

Geological information about the Earth's crust is huge. The brief data about it are examined below.

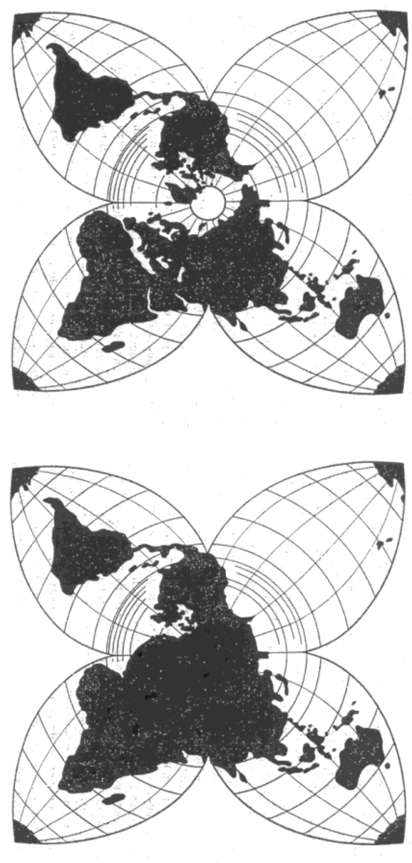

Figure 3

The plan position of the Earth's continents in North hemisphere – 'continental star': up – present position with put down 'Arctic continent' under water of North Ice Ocean (Kulikov. 1985), down - position them 300 Ma ago, as united dry superlarge continent (Pangeya), taking into account data (Serpuchov et el. 1976, Kashubin et el. 2013)

Continents

The Northern hemisphere of the Earth comprises two large continents: the North-American and the Euro-Asiatic continents, both of which share the Atlantic Ocean and North Ice Ocean. Over 300 million years ago, however, these continents were connected in the north and represented united continent, united dry land, so-called Pangeya (Hallam.1985, Serpuhov et el. 1976, Shipilov et el. 2009). Thus, all continents of the Earth's northern hemisphere were once a large continent (Figure 2). It was united on the North and breaking up on the South, with sharp narrowing ends of the separate continents. So it had a specific form of land that resembled like carrot with separate narrow roots below (Figure 3). All continents formed initially in deep hollows (30-50 km) on primary peridotite mantle (Figure 4). The geological structure of the continents and the ocean floor are identified separately, differing of thickness, composition, and structure. These differences were discovered by geologists during the early 20th century. Proof of it was certified by subsequent geological and geophysical investigations (Figures 4 & 5). The continental crust is composed of two main lower layers - granite–gneiss (sialic) layer with a thickness ranging from 5 to 25 km, and granulite–basic layer thickness near 10-30 km. Both layers make up the foundation of the continents (Figures 4 & 5). But in 'Arctic continent' granulite–basic layer is thick – 10-16 km, while granite–gneiss is thing, from 2-5 km till 16 km (Kashubin et al. 2013). For example, under island Iceland common

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thickness of the crust is 28 km while the thickness of granit-gneiss layer is 15 km (Serpuhov et al. 1976). Granite–gneiss layer is not found below the oceans; instead, the ultrabasic upper mantle is found near the surface of the ocean floor. This mantle comprises a gabbro–peridotite layer that is 5 km thick and often undergoes serpentinization. Above this layer is a young and thin layer of basalt of Mesozoic-Kainozoic age. Magma flows on the surface of the upper mantle directly through numerous vertical faults, which cross the upper crust of the primary mantle. The basalt layer is covered with a thin layer (100 m to 500 m) of crumbling rocks (see Table 1). Accordingly, upper mantle (until depth 400 - 600 km) contents very few incompatible elements. These elements were extracted by endogenic fluids and were carried out to the upper regions of the continental crust. 'Oceanic' crust represented by primitive tholeitic basalts, on the contrary, contents not enough pointed incompatible elements, especially potassium, and the upper mantle under it is differentiated a little and like chondrites from cosmos, on concentration of incompatible elements (Khain et el. 2007, Voitkevich. 1979).

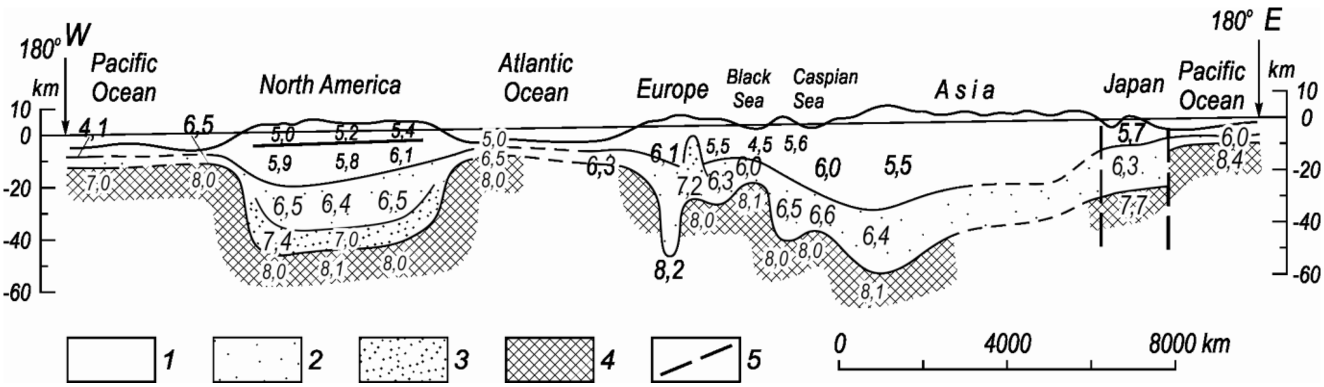

Figure 4

The geology - geophysics section of the Earth's north hemisphere (latitude 45° n. l.). On G. Kloos, K. Benke (Khain. 1964, Rodnikov. 2007)
1 – precipitation and 'granite'; 2 – 'upper basalt'; 3 –'down basalt'; 4 – peridotite layer. Figures – velocity of longitudinal seismic waves.

3.3. Geological development of the continents and oceanic crusts of the Earth

The geological development of the different planetary structures was carried out during all geological history on various algorithms. After the astronomic period of the Earth, both types of geological structures appeared simultaneously, specifically during the Hadean period (4.4 – 4.0 Ga ago). However, the following ways of development them have become differed.

«Oceanic» crust

The primary crust on areas of present oceans crystallized slowly during the Hadean period. This crust had anorthosite–peridotite composition. From 4 Ga to the 0,2 Ga (early MZ period), this primary crust remained invariable: "on oceanic areas early thin ultrabasic crust without any changes existed until the end of the Paleozoic" (Schlezinger. 2003, p.87). During the MZ–KZ period, this crust was unevenly lowered and covered with a basalt layer thinly blanketed by friable precipitation and ocean water. Similar conclusion is stated in previous work: "on other spaces sialization of the crust apparently did not occur. The thick basalt cover lay down on primary mantle crust at the end of the Mesozoic time "(Andreev et el. 1999, p. 28). Thus, until the MZ period, this primary peridotite crust was under passive conditions. The actual geological development of the crust began during the MZ-KZ period when the great stage of tectonics diastrofism began on the planet. In that time the huge territories of primary mafic crust had began put down deep (Figures 6). During the KZ period, some parts of the oceanic crust began to break away intensively, whereas others began to rise. A system of median-oceanic ridges with axial rifts formed in these parts. Under the influence of oceanic waters, the primary mantle underwent serpentinization and crossed over a huge number of dykes with gabbro–peridotite compositions. Thus, the dykes had controlled themselves numerous channels for taking out of upper mantle's basalt lava to the oceanic bottom. Emphasis must be placed on the fact that the peridotite composition of the Earth is also a characteristic of other planets of the solar system as well as of asteroids and meteorites. The ultramafic composition of Earth's mantle reflects the main cosmogony feature of the terrestrial group's planet formation – formation of the Fe–Mg silicates (Voitkevich. 1979). Thus the oceanic crust is characterized using other algorithms of geological development.

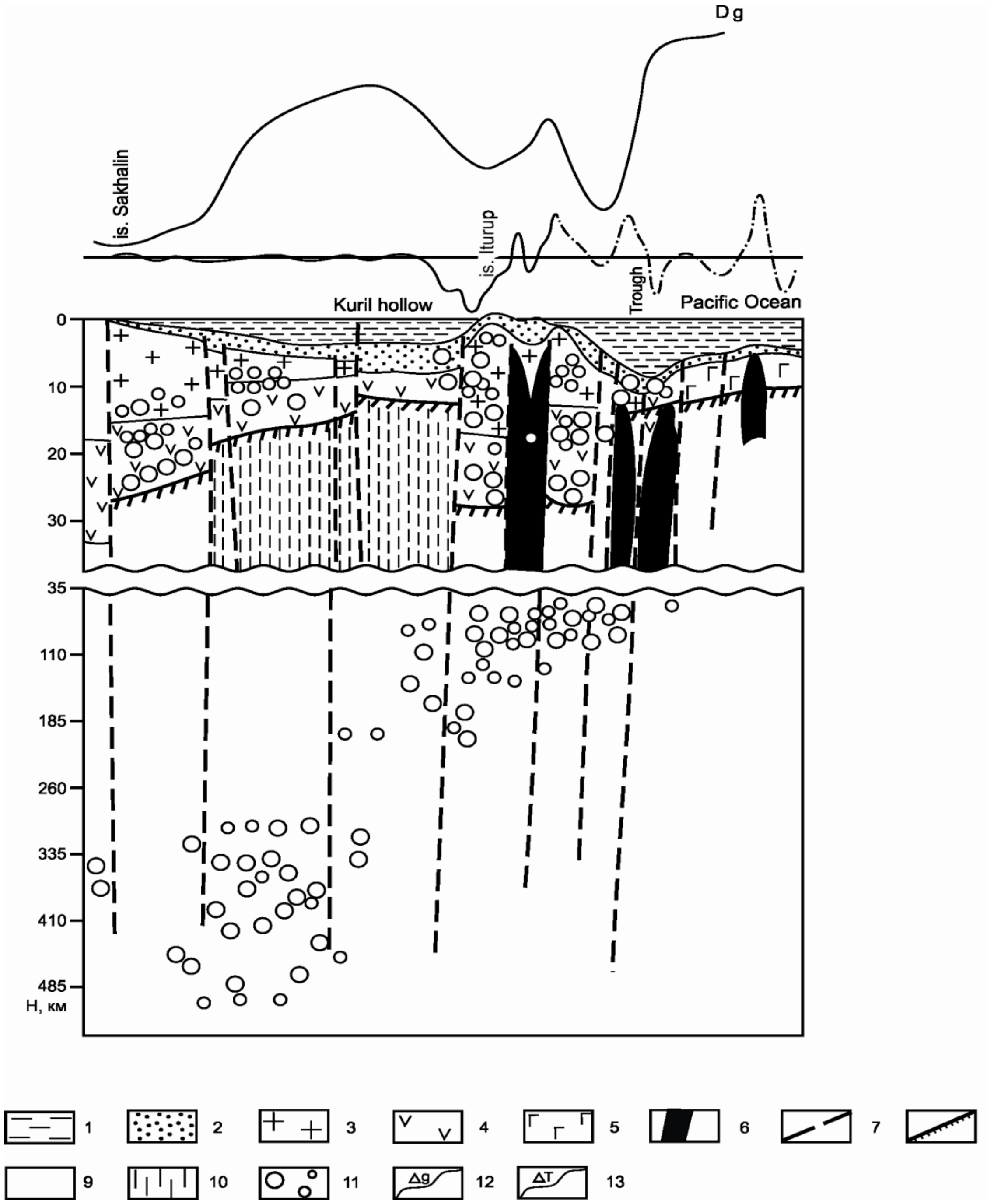

Figure 5

The geology - geophysics section on line: island Sakhalin – island Iturup - Pacific Ocean [16, 26, 31].
1 – sea water; 2 – sedimentary and volcanic rocks (MZ-CZ); 3 - granite- gneiss layer; 4 - granulite-basic layer; 5 – basalt layer and gabbro-serpentine layer of 'oceanic' crust; 6 - vertical dykes of ultrabasit composition; 7 – faults;; 8 – a border of Moho; 9 – upper mantle s; 10 – upper mantle with abnormally high thermal flow; 11 – the hypocentres of earthquakesю Above figure: 12 - Δg – curve of gravity field; 13 - ΔT – curve of magnetic field.

Continent earth crust

The lower basalt layer of the continents was formed during the early period of geological history (Hadean). The hollow spaces on the destroyed surface of the upper mantle were filled with huge volumes of basalt magma smelted from the peridotite magma of the upper mantle. These basalts transformed into a thick granulite–basic layer under hot temperature and high pressure (700 °C – 1000 °C and 5 – 10 kbar, respectively) (Pavlovskiy. 1975, Rezanov. 2006). During the Archean period, deep round basins (15-25 km) formed with sea water, and sedimentation thick layers of the sedimentary rocks began forming. Then sedimentary layers were

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crumpled in folds, raised in mountain chains and are subjected to repeated granitoid magmatism and metamorphism under the influence of hydrogen-silicon nuclear fluids. As a result, some of underlying granulite-basic rocks and rocks of tonalit-trondyemit-granodiorite composition ('gray gneisses') were formed. These two layers of the continents' formed the foundation of them. The formation of the sialic layer is the longest period in the geological history of the Earth (from 4.0 Ga to 1.8 Ga). This formation is the peculiar feature of the development of the Earth. Ancient rocks differ in several characteristics: 1) the huge scale of their manifestation, that is, they became the foundation of all modern continents, 2) the strongest metamorphism of rocks under granulite conditions, 3) the domination of the plastic deformation of rocks, 4) the massive and universal formation of isometric and oval forms, which is characteristic of sedimentary fold structures and magmatic bodies (Belousov. 1985, Salop. 1982). Subsequent tectonic-magmatogeny processes during the Proterozoic and Paleozoic periods manifested mainly at the edges of ancient platforms, where is formed sedimentary layer on the consolidated base of continents. Inside of these platforms, large parts of the terrain were lowered and filled with horizontal layers of sedimentary rocks. These formations represent the upper layer of rocks for ancient and modern platforms. The result is the contemporary appearance of the continents. Besides, the formations of the specific continental crust with sialic composition predetermined its enrichment of silica, oxygen, carbon, a number of incoherent elements (K, Na, Ba, U, TR and others), including many heavy metallic elements – some of that occur in Earth's liquid core (Belousov. 1985, Voitkevich. 1979). Thus, the continental crust is very specific.

Table 1

Comparative characteristics of the Earth's continental and 'oceanic' crust (Belousov. 1962, Kashubin et el. 2013, Rezanov. 1974, Salop.1982, Vasiliev. 2009)

Parameters	Continental crust	'Oceanic' crust
Thick, км	30 - 40, until 50 -70	5 - 7
The crust's structure	Three fold layers	Three horizontal layers
Composition of the crust's layers (upper –down)	Sedimentary, of thick 0 - 25 км, with fold belts Granite-gneiss, thick 5 - 20 км Granulite - basic layer, thick 10-30 км (primary basalt layer smelted from mantle; later – transformed by the new core fluids)	Sedimentary horizontal layer, of thick 0,3 -1 км Granite-gneiss layer is absent. Basalt cover is instead of it , thick 1-2 км Gabbro - peridotite layer, thick - 5 км (primary crust of mantle, injected of dykes in MZ-KZ time)
Geochemistry type	Sialic type, with O, Si, Al, Na, K, Ca, Ba	Femic type, with Fe, Mg
Geological age of down layer	Hadean, 4,4 – 4,0 Ga ago	Hadean, 4,4 – 4,0 Ga ago with plutonic magma injection in MZ – KZ time

3.4. Vertical geodynamics of tectonic movements

As it is shown above, the geological development of the continents was achieved after vertical tectonic movements excited on border of the Earth's outer core and transferred to the crust (by hot fluids). Such processes may be repeated repeatedly. In lower basins that accumulated sedimentary rocks, lift blocks (horsts) formed intrusive bodies and fold structures of sedimentary rocks. An example is the east edge of the Euro-Asia continent, as shown in Figures 7. The border between the continental and oceanic crust is presently controlled often by the position of deep water rift or through (width till 50 km), crossing over a series of longitudinal faults at a short distance. This border is vertical usually or slightly inclined to the continental or oceanic side (Vasiliev. 2009, Zhirnov. 2011$_1$). A deep water rift was formed during the KZ period. In previous geological periods, this border was located near the continental surface level and was constant always (Rodnikov. 2007, Zhirnov. 2011$_1$). The peculiar geological structures near the edge of the continent are shown on Figures 4-6. The formation of gigantic dyke belts with basic–ultrabasic composition is the characteristic feature of the east edge of the continent. Two structures cross the Kamchatka peninsula in the north – east direction. The third structure was formed on the east edge of the continent (under water) and on flanks of the chain islands of Kuril. The other belt stretches along the edges of the Honshu–Sakhalin tectonic horst, which lies in the longitude faults of the planet (Khain. 1964, Zhirnov. 2011$_1$).

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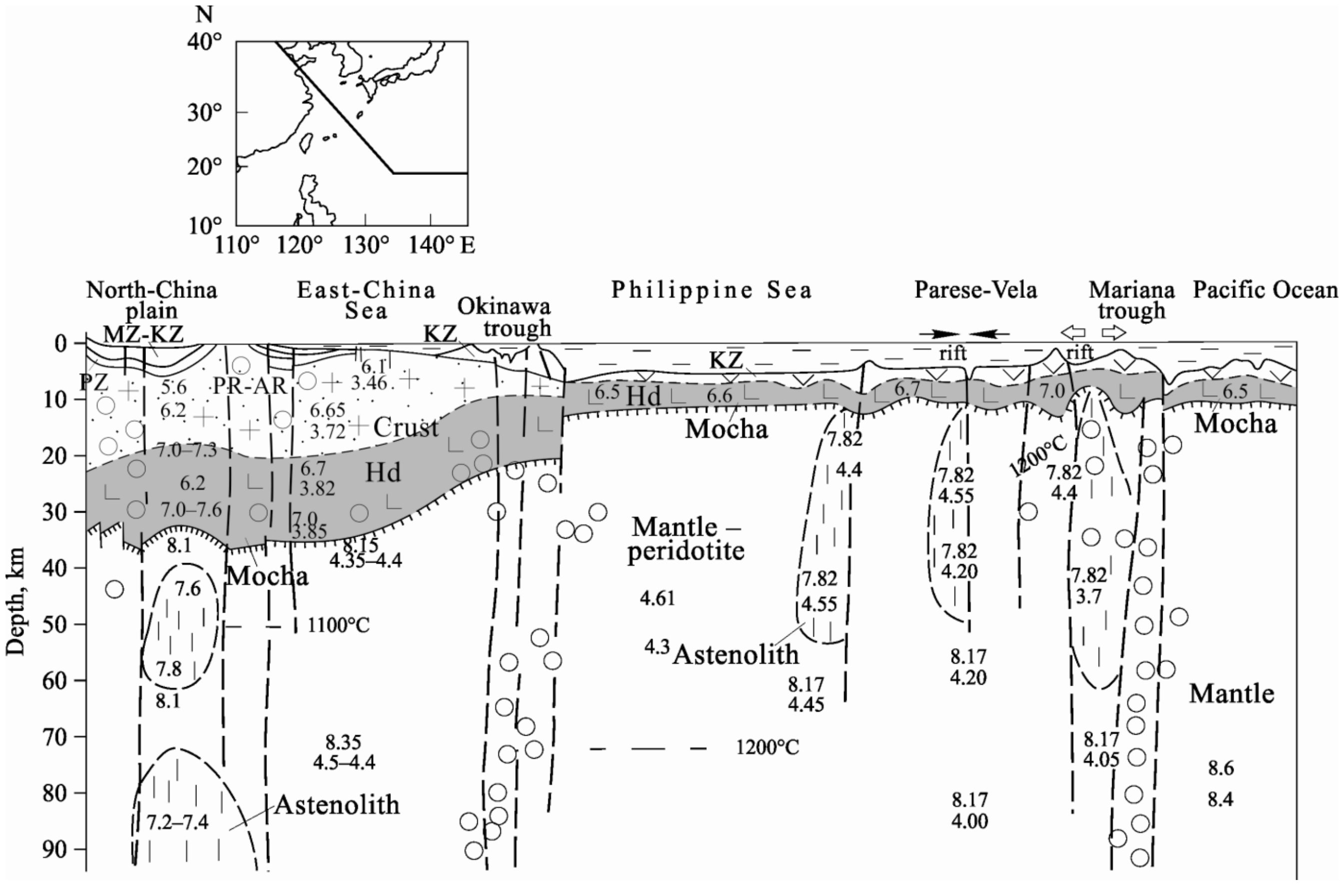

Figure 6

The geology-geophysics section on line East China – Philippine Sea – Mariana trough – Pacific Ocean (Rodnikov. 2007), which making more precise. Figures – velocity of longitudinal and diametrical (in denominator) seismic waves, small disks - the hypocentres of earthquakes.

3. 5. Dynamics of the Earth's core

At the geological stage of the Earth's evolution, the geodynamics of the Earth's core continued to play a leading role in the further development of the Earth. The external liquid core which covers the central firm core contained a huge amount of high-temperature gases that remained after the astronomical stage of planet's development. Complicated non-equilibrium processes of substance differentiation in a liquid core were caused by the transition of parts of the substance into a firm core and by the periodic accumulation of high energy plumes on the border of the mantle and the external liquid core. These fluids (strongly compressed gas with metall elements) periodically jumped out to the mantle in the form of highly permeable, thermo- chemical power stream plumes (Letnikov. 2001, Zhirnov. 20112, Zhirnov. Bormotov. 1999). Global magma-tectonic processes (or a catastrophism of deep events) in the Earth's core happened periodically every 200 Ma years during the Paleozoic and MZ periods and every 300 Ma to 500 Ma years during the Pre-Cambrian period (Khain. 1964, Salop.1982). During these periods, huge volumes of plumes jumped out from the liquid core to the mantle, generating linear magma-tectonic belts and the transformation of large areas of the crust (Figures 8). Many emitted plumes during the Hadean–Archean period were especially large predetermining the emergence of large ancient two - layers platforms of the Earth that became of consolidated base for the present Continents. Thus studies of the Earth's crust have revealed significant heterogeneities of the Earth that formed during the early periods of the Earth's geological history and even earlier—in the astronomic period of the Earth's history: «forming of the continents in one half-sphere of the planet is proving a fact that the process of the differentiation of the mantle was began very long ago…had one trend in the space and having had undoubted relate to the method forming of the Earth's primary shells» (Voitkevich. 1979, p. 81). Now many researchers share such opinion (Vasiliev. 2009, Zhirnov. 2005, Zhirnov. 2008). But the cause of the continents' formation on certain fixed plates of the planet – a theme of other conversation.

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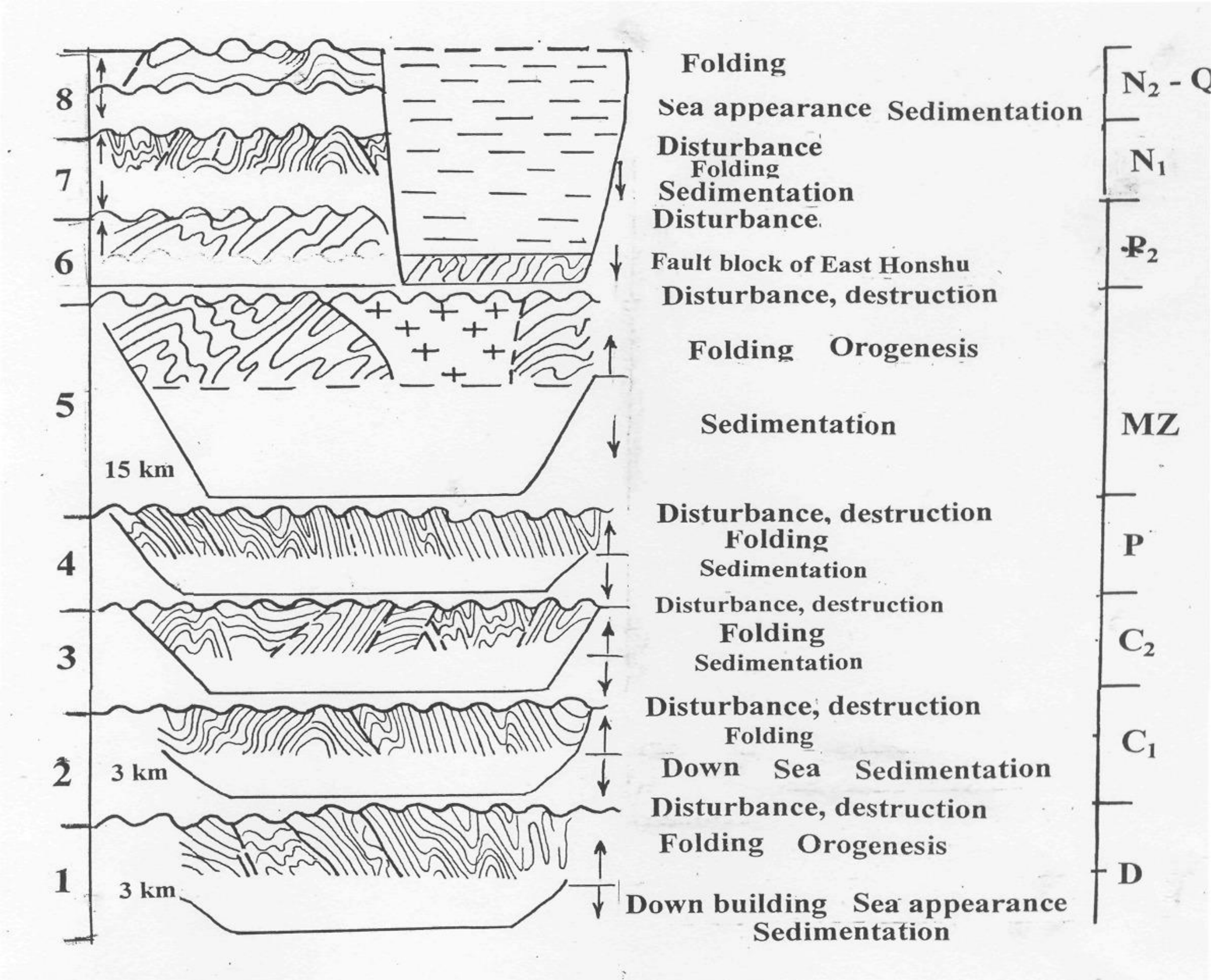

Figure 7

Policycle geological development of the North Honshu' island (Japan) from Devonian to Quarter period – under influence of vertical tectonic movements, down – up. Taking into account data (Bersenev et el.1985, Vasiliev. 2009, Zhirnov. 2012)

4. DISCUSSION

The materials stated above on formation of the united northern continent (Pangeya) and Antarctic southern continent since the beginning of geological history in strictly fixed places of a planet, testify to their continuous spatial situation during all geological history. Therefore, existing hypothesis of big horizontal movements of continents and earth's plates are incorrect. Continents are active geological structures which always were formed under acting of vertical tectonic movements and never moved in horizontal direction while peridotite crust and mantle under modern oceans always remained passive till Mesozoic-Kainozoic time.

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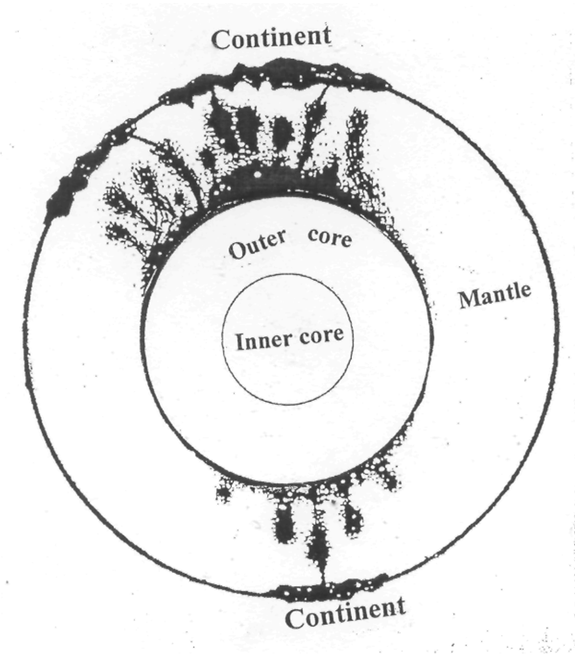

Figure 8
The model of Earth's forming continental crust (Zhirnov).

5. CONCLUSION

The Earth's continents represented a very thick geochemistry specific crust and formed during all geological history of a planet are the gigantic tectonics and geochemistry anomalies on peridotite body of Earth, the other words – something specific growths on it.

SUMMARY OF RESEARCH

1. The continents of Earth are active geological structures that have actively formed since the emergence of the primary Earth's crust (Hadean period). A major part of the continents' geological section (80 %) was formed during ancient times (4,4 Ga to 1,8 Ga ago) that comprised two layers of consolidated base with basic (lower layer) and sialic compositions (upper layer). Already in that time the North united continent (Pangeya) with tree continental rays (apophyses) was created. And only after Paleozoic time the central part of it was put down and cover waters of the North Ice Ocean.
2. Continents have continuously been forming under the selective influence of core fluids that move toward the bottom of the continents.
3. Continents are large tectonic and geochemistry anomalies of the planet with sialic composition. More specifically, continents are sial "growths" on peridotite body of the Earth, appearing on surface upper mantle under long influence of hydrogen-silica-oxygen fluids acting from the Earth's liquid core.
4. 'Oceanic' crust appeared in upper part of peridotite mantle initially and was passive land (third layer of present oceanic crust) during 4 Ga. Only recently it was broken of faults, put down and covered a layer of young basalt and precipitations, and also – oceanic water.

FUTURE ISSUES

I believe that many scientists in sphere of sciences about Earth have to pay attention to the real geologic-geophysical data obtained by geological science for 150 years and summarized a little in this work. Apparently, ripened time to refuse in geology from any assumptions and hypothesis existing in modern geotectonic.

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Conflicting interests
The authors declare that there are no conflicts of interests.

Data and materials availability
All data associated with this study are present in the paper.

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